SIEMENS

6N138
6N139
LOW INPUT CURRENT, HIGH GAIN OPTOCOUPLER

FEATURES
- **High Current Transfer Ratio, 800%**
- **Low Input Current, 0.5mA**
- **High Output Current, 60mA**
- **Isolation Test Voltage, 2500 VAC_{RMS}**
- **TTL Compatible Output, VOL=0.1 V**
- **High Common Mode Rejection, 500V/µsec.**
- **Adjustable Bandwidth–Access to Base**
- **Standard Molded Dip Plastic Package**
- **Underwriters Lab File #E52744**

APPLICATIONS
- **Logic Ground Isolation–TTL/TTL, TTL/CMOS, CMOS/CMOS, CMOS/TTL**
- **EIA RS 232C Line Receiver**
- **Low Input Current Line Receiver–Long Lines, Party Lines**
- **Telephone Ring Detector**
- **117 VAC Line Voltage Status Indication–Low Input Power Dissipation**
- **Low Power Systems–Ground Isolation**

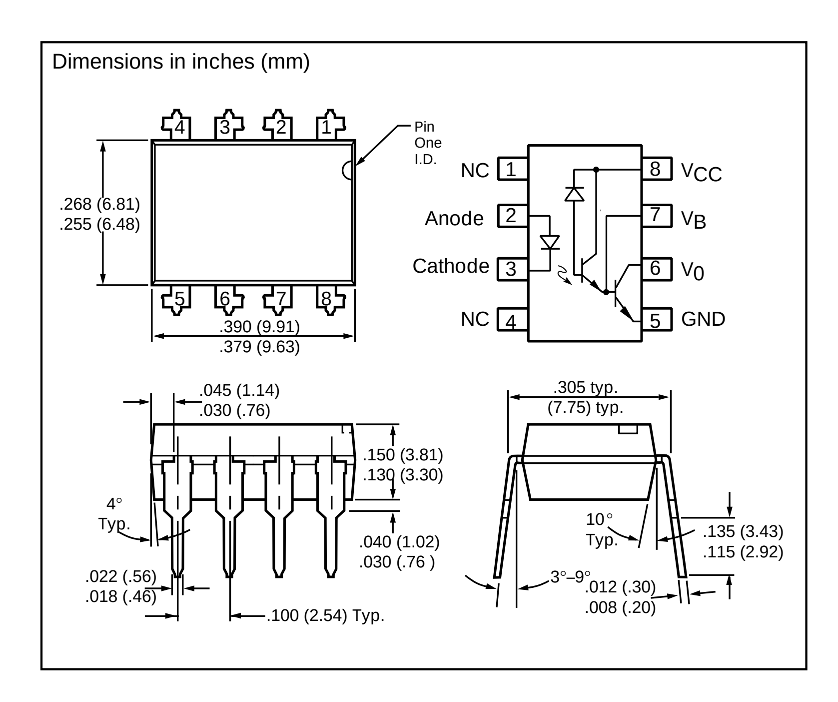
DESCRIPTION
High common mode transient immunity and very high current ratio together with 2500 VAC insulation are achieved by coupling an LED with an integrated high gain photo detector in an eight pin dual-in-line package. Separate pins for the photodiode and output stage enable TTL compatible saturation voltages with high speed operation. Photodarlington operation is achieved by tying the V_{CC} and V_O terminals together. Access to the base terminal allows adjustment to the gain bandwidth.

The 6N138 is ideal for TTL applications since the 300% minimum current transfer ratio with an LED current of 1.6 mA enables operation with one unit load-in and one unit load-out with a 2.2 KΩ pull-up resistor.

The 6N139 is best suited for low power logic applications involving CMOS and low power TTL. A 400% current transfer ratio with only 0.5 mA of LED current is guaranteed from 0°C to 70°C.

Caution:

Due to the small geometries of this device, it should be handled with Electrostatic Discharge (ESD) precautions. Proper grounding would prevent damage further and/or degradation which may be induced by ESD.



Maximum Ratings

Reverse Input Voltage	5 V
Supply and Output Voltage, V_{CC} (pin 8-5), V_O (pin 6-5)	
6N138	–0.5 to 7 V
6N139	–0.5 to 18 V
Emitter-Base Reverse Voltage (pin 5-7)	0.5 V
Average Input Current	20 mA
Peak Input Current (50% Duty Cycle–1 ms pulse width)	40 mA
Peak Transient Input Current (tp≤1 µsec, 300 pps	1.0 A
Output Current I_O (pin 6)	60 mA
Derate linearly above 25°C, free air temperature at 0.7 mA/°C	
Input Power Dissipation	35 mW
Derate linearly above 50%, free air temperature at 0.7 mW/°C	
Output Power Dissipation	100 mW
Derate linearly above 25°C, free air temperature at 0.2 mA/°C	
Isolation Test Voltage	2500 VAC_{RMS}
Isolation Resistance	
V_{IO}=500 V, T_A=25°C	≥10^{12} Ω
V_{IO}=500 V, T_A=100°C	≥10^{11} Ω
Storage Temperature	–55°C to +125°C
Operating Temperature	–55°C to +100°C
Lead Soldering Temperature (t=10 sec.)	260°C

Electro-Optical Characteristics (T_A=0°C to 70°C, T_A=25°C–Typical, unless otherwise specified)

Parameter	Symbol	Device	Min.	Typ.	Max.	Units	Test Conditions	Note
Current Transfer Ratio	CTR	6N138	300	1600		%	I_F=1.6 mA, V_O=0.4 V, V_{CC}=4.5 V	5.6
		6N139	400 500	1600 2000		%	I_F=0.5 mA, V_O=0.4 V, V_{CC}=4.5 V I_F=1.6 mA, V_O=0.4 V, V_{CC}=4.5 V	5.6
Logic Low Output Voltage	V_{OL}	6N138		0.1	0.4	V	I_F=1.6 mA, I_O=4.8 mA, V_{CC}=4.5 V	6
		6N139 6N139 6N139		0.1 0.15 0.25	0.4 0.4 0.4	V	I_F=1.6 mA, I_O=8 mA, V_{CC}=4.5 V I_F=5 mA, I_O=15 mA, V_{CC}=4.5 V I_F=12 mA, I_O=24 mA, V_{CC}=4.5 V	6
Logic High Output Current	I_{OH}	6N138		0.1	250	µA	I_F=0 mA, V_O=V_{CC}=7 V	6
		6N139		0.05	100	µA	I_F=0 mA, V_O=V_{CC}=18 V	6
Logic Low Supply Current	I_{CCL}			0.2	1.5	mA	I_F=1.6 mA, V_O=OPEN, V_{CC}=18 V	6
Logic High Supply Current	I_{CCH}			0.001	10	µA	I_F=0 mA, V_O=OPEN, V_{CC}=18 V	6
Input Forward Voltage	V_F			1.4	1.7	V	I_F=1.6 mA, T_A=25°C	
Input Reverse Breakdown Voltage	BV_R		5			V	I_R=10 µA	
Temperature Coefficient of Forward Voltage				-1.8		mV/°C	I_F=1.6 mA	
Input Capacitance	C_{IN}			25		pF	f=1 MHz, V_F=0	
Input-Output Insulation Leakage Current	I-0				1.0	µA	45% Relative Humidity, T_A=25°C t=5_S, V_{1-0}=3000 VDC	7
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	V_{IO}=500 VDC	7
Capacitance (Input-Output)	C_{I-O}			0.6		pF	f=1 MHz	7

Switching Specifications (T_A=25°C)

Parameter	Symbol	Device	Min.	Typ.	Max.	Units	Test Conditions	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	6N138		2	10	µS	I_F=1.6 mA, R_L=2.2 KΩ	
		6N139		6 0.6	25 1	µS	I_F=0.5 mA, R_L=4.7 KΩ I_F=12 mA, R_L=270 Ω	6,8
Propagation Delay Time To Logic High at Output	t_{PLH}	6N138		2	35	µS	I_F=1.6 mA, R_L=2.2 KΩ	
		6N139		4 1.5	60 7	µS	I_F=0.5 mA, R_L=4.7 KΩ I_F=12 mA, R_L=270 Ω	6,8
Common Mode Transient Immunity at Logic High Level Output	CM_H			500		V/µS	I_F=0 mA, R_L=2.2 KΩ R_{CC}=0/V_{CM}/=10 V_{p-p}	9,10
Common Mode Transient Immunity at Logic Low Level Ouput	CM_L			–500		V/µS	I_F=1.6 mA, R_L=2.2 KΩ R_{CC}=0/V_{CM}/=10 V_{p-p}	9,10

Notes

1. Derate linearly above 50°C free-air temperature at a rate of 0.4 mA/°C.
2. Derate linearly above 50°C free-air temperature at a rate of 0.7 mW/°C.
3. Derate linearly above 25°C free-air temperature at a rate of 0.7 mA/°C.
4. Derate linearly above 25°C free-air temperature at a rate of 2.0 mW/°C.
5. DC current transfer ratio is defined as the ratio of outppput collector current, IO, to the forward LED input current, IF times 100%.
6. Pin 7 open.
7. Device considered a two-terminal device: pins 1, 2, 3 and 4 shorted together and pins 5, 6, 7 and 8 shorted together.
8. Using a resistor between pin 5 and 7 will decrease gain and delay time.
9. Common mode transient immunity in logic high level is the maximum tolerable (positive) dVcm/dt on the leading edge of the common mode pulse, V_{CM}, to assure that the output will remain in a logic high state (i.e. V_O>2.0 V) common mode transient immunity in logic low level is the maximum tolerable (negative) dVcm/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a logic low state (i.e. V_O<0.8 V).
10. In applications where dv/dt may exceed 50,000 V/µs (such as state discharge) a series resistor, R_{CC} should be included to protect I_C from destructively high surge currents. The recommended value is $R_{CC} \cong \frac{IV}{0.15 I_F (mA)} k\Omega$